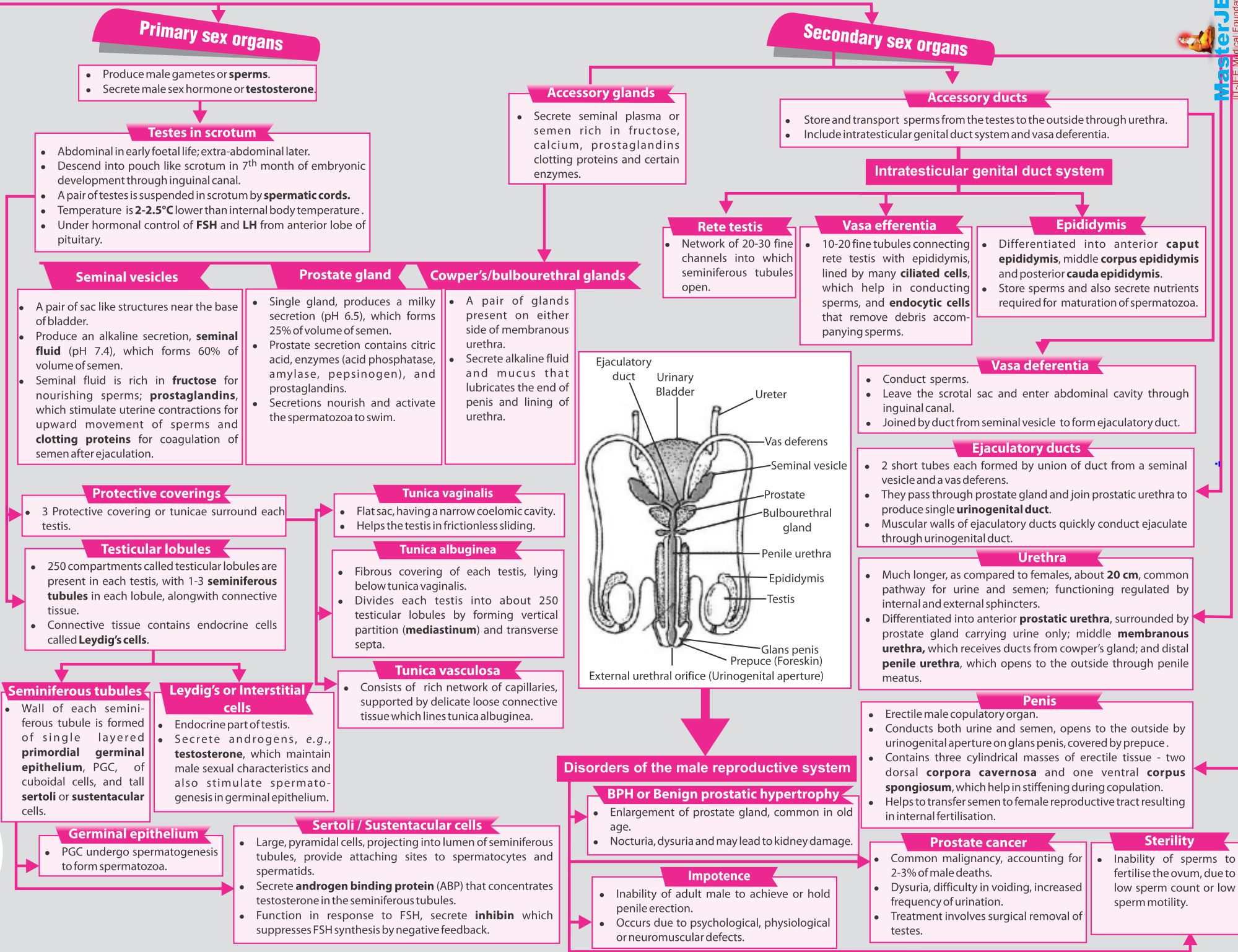


HUMAN MALE REPRODUCTIVE SYSTEM

The male reproductive system is located in the pelvic region. It is a system of sex organs and accessory glands. Its main functions are:-

- Production of sperms by spermatogenesis.
- Secretion of male sex hormone testosterone.
- Ensures internal fertilisation.

CONCEPT MAP



Primary sex organs

- Produce male gametes or **sperms**.
- Secrete male sex hormone or **testosterone**.

Testes in scrotum

- Abdominal in early foetal life; extra-abdominal later.
- Descend into pouch like scrotum in 7th month of embryonic development through inguinal canal.
- A pair of testes is suspended in scrotum by **spermatic cords**.
- Temperature is **2-2.5°C** lower than internal body temperature.
- Under hormonal control of **FSH** and **LH** from anterior lobe of pituitary.

Seminal vesicles

- A pair of sac like structures near the base of bladder.
- Produce an alkaline secretion, **seminal fluid** (pH 7.4), which forms 60% of volume of semen.
- Seminal fluid is rich in **fructose** for nourishing sperms; **prostaglandins**, which stimulate uterine contractions for upward movement of sperms and **clotting proteins** for coagulation of semen after ejaculation.

Prostate gland

- Single gland, produces a milky secretion (pH 6.5), which forms 25% of volume of semen.
- Prostate secretion contains citric acid, enzymes (acid phosphatase, amylase, pepsinogen), and prostaglandins.
- Secretions nourish and activate the spermatozoa to swim.

Cowper's/bulbourethral glands

- A pair of glands present on either side of membranous urethra.
- Secrete alkaline fluid and mucus that lubricates the end of penis and lining of urethra.

Protective coverings

- 3 Protective covering or tunicae surround each testis.

Testicular lobules

- 250 compartments called testicular lobules are present in each testis, with 1-3 **seminiferous tubules** in each lobule, alongwith connective tissue.
- Connective tissue contains endocrine cells called **Leydig's cells**.

Tunica vaginalis

- Flat sac, having a narrow coelomic cavity.
- Helps the testis in frictionless sliding.

Tunica albuginea

- Fibrous covering of each testis, lying below tunica vaginalis.
- Divides each testis into about 250 testicular lobules by forming vertical partition (**mediastinum**) and transverse septa.

Tunica vasculosa

- Consists of rich network of capillaries, supported by delicate loose connective tissue which lines tunica albuginea.

Seminiferous tubules

- Wall of each seminiferous tubule is formed of single layered **primordial germinal epithelium**, PGC, of cuboidal cells, and tall **Sertoli** or **sustentacular** cells.

Leydig's or Interstitial cells

- Endocrine part of testis.
- Secrete androgens, e.g., **testosterone**, which maintain male sexual characteristics and also stimulate spermatogenesis in germinal epithelium.

Germinal epithelium

- PGC undergo spermatogenesis to form spermatozoa.

Sertoli / Sustentacular cells

- Large, pyramidal cells, projecting into lumen of seminiferous tubules, provide attaching sites to spermatocytes and spermatids.
- Secrete **androgen binding protein** (ABP) that concentrates testosterone in the seminiferous tubules.
- Function in response to FSH, secrete **inhibin** which suppresses FSH synthesis by negative feedback.

Secondary sex organs

Accessory glands

- Secrete seminal plasma or semen rich in fructose, calcium, prostaglandins clotting proteins and certain enzymes.

Accessory ducts

- Store and transport sperms from the testes to the outside through urethra.
- Include intratesticular genital duct system and vasa deferentia.

Intratesticular genital duct system

Rete testis

- Network of 20-30 fine channels into which seminiferous tubules open.

Vasa efferentia

- 10-20 fine tubules connecting rete testis with epididymis, lined by many **ciliated cells**, which help in conducting sperms, and **endocytic cells** that remove debris accompanying sperms.

Epididymis

- Differentiated into anterior **caput epididymis**, middle **corpus epididymis** and posterior **cauda epididymis**.
- Store sperms and also secrete nutrients required for maturation of spermatozoa.

Vasa deferentia

- Conduct sperms.
- Leave the scrotal sac and enter abdominal cavity through inguinal canal.
- Joined by duct from seminal vesicle to form ejaculatory duct.

Ejaculatory ducts

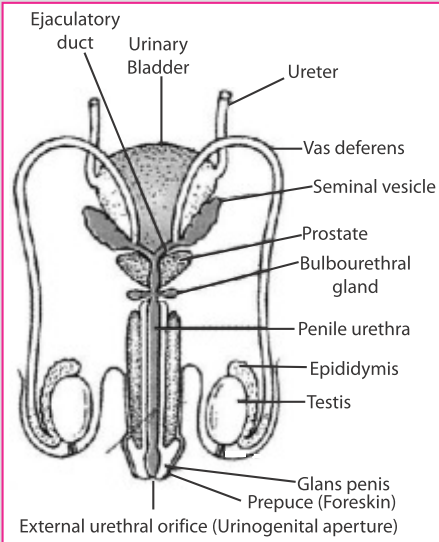
- 2 short tubes each formed by union of duct from a seminal vesicle and a vas deferens.
- They pass through prostate gland and join prostatic urethra to produce single **urinogenital duct**.
- Muscular walls of ejaculatory ducts quickly conduct ejaculate through urinogenital duct.

Urethra

- Much longer, as compared to females, about **20 cm**, common pathway for urine and semen; functioning regulated by internal and external sphincters.
- Differentiated into anterior **prostatic urethra**, surrounded by prostate gland carrying urine only; middle **membranous urethra**, which receives ducts from Cowper's gland; and distal **penile urethra**, which opens to the outside through penile meatus.

Penis

- Erectile male copulatory organ.
- Conducts both urine and semen, opens to the outside by urinogenital aperture on glans penis, covered by prepuce.
- Contains three cylindrical masses of erectile tissue - two dorsal **corpora cavernosa** and one ventral **corpus spongiosum**, which help in stiffening during copulation.
- Helps to transfer semen to female reproductive tract resulting in internal fertilisation.



Disorders of the male reproductive system

BPH or Benign prostatic hypertrophy

- Enlargement of prostate gland, common in old age.
- Nocturia, dysuria and may lead to kidney damage.

Impotence

- Inability of adult male to achieve or hold penile erection.
- Occurs due to psychological, physiological or neuromuscular defects.

Prostate cancer

- Common malignancy, accounting for 2-3% of male deaths.
- Dysuria, difficulty in voiding, increased frequency of urination.
- Treatment involves surgical removal of testes.

Sterility

- Inability of sperms to fertilise the ovum, due to low sperm count or low sperm motility.

HUMAN FEMALE REPRODUCTIVE SYSTEM

The human female reproductive system is located in the pelvic region and consists of a pair of ovaries, along with a pair of oviducts, uterus, cervix, vagina, external genitalia and glands. Breasts or mammary glands are considered part of the female reproductive system, because of their role in nourishing the offspring. Main functions of female reproductive system are:

- Production of ova by oogenesis.
- Fertilization, pregnancy, giving birth and child care.
- Secretion of female sex hormones e.g., estrogen, progesterone, etc.

CONCEPT MAP

Primary sex organs

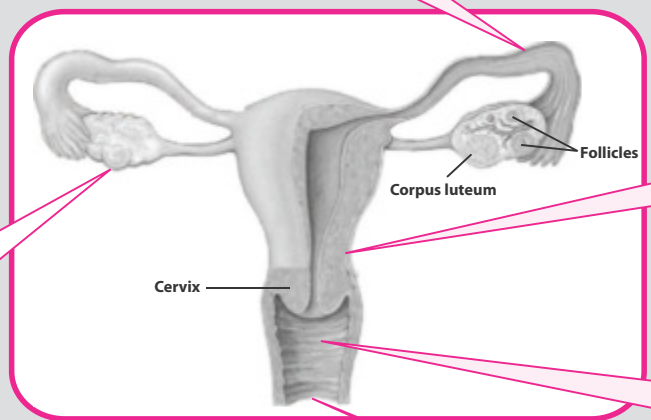
Secondary sex organs

Ovary

- Paired structures located in upper pelvic cavity.
- 2 to 4 cm in length, shaped like an unshelled almond.
- Ovarian ligament attaches the ovary to uterus.
- Covered by a layer of cubical epithelium called the germinal epithelium and further by visceral peritoneum. Beneath the epithelium is **tunica albuginea**- a layer of connective tissue.
- Underlying tunica albuginea is the ovarian **stroma**, differentiated into dense outer layer called **cortex**, and a less dense inner portion called **medulla**.
- Interspersed throughout the cortex are many ovarian follicles in different stages of development and are called primary, secondary, tertiary and Graafian (mature) follicles.
- A mature Graafian follicle consists of an oocyte surrounded by a homogenous membrane **zona pellucida** and radially elongated follicle cells called **corona radiata**, further surrounded by follicular cells forming **membrana granulosa**.
- Granulosa cells are differentiated into outer fibrous **theca externa** and inner cellular **theca interna** which secrete a fluid called **liquor folliculi** creating a large cavity called **antrum** or follicular cavity.
- Oocyte adheres to the granulosa layer by a stalk called **cumulus ovaricus** or **cumulus oophorus**.
- Total number of follicles in two ovaries of a normal young adult woman is about four lakhs, but only 450 mature during the entire reproductive span. Many ovarian follicles undergo degeneration, called **follicular atresia**.
- Graafian follicle releases an oocyte during ovulation and converts into a yellow body called **corpus luteum**, which secretes mainly progesterone and some relaxin hormone.
- In absence of fertilization, corpus luteum degenerates about 12 days after ovulation becoming the corpus albicans which is replaced by connective tissue and over months is absorbed.
- Ovaries perform two functions: production of ova and secretion of female sex hormones.

Fallopian tube/oviduct

- There are two Fallopian tubes and each is about 10-12 cm long consisting of infundibulum, ampulla and isthmus.
- The **infundibulum** is a dilated trumpet-like portion of the Fallopian tube, with fingerlike projections called **fimbriae**, and an **ostium** which helps in collection of the ovum after ovulation.
- **Ampulla** is the widest and longest part of the Fallopian tube. **Isthmus** is the short, narrow thick-walled portion that follows the ampulla. Fertilization of ovum occurs at the **ampullary-isthmic junction**.
- **Uterine part** passes through the uterine wall and communicates with the uterine cavity.
- Function of the Fallopian tube is to convey the ovum from ovary to the uterus by peristalsis.



Uterus

- Also known as metra/hystera/womb.
- It is a hollow muscular, inverted pear shaped structure lying in the pelvic cavity between the urinary bladder and the rectum.
- It is differentiated into the following parts:
 - Fundus** is the upper dome-shaped part of the uterus, above the openings of the uterine parts of the Fallopian tubes.
 - Cornua (sing. cornu)** are upper corners where the oviducts enter the uterus.
 - Body** is the main part, which is narrowest inferiorly, where it continues with the cervix.
 - Cervix** joins the anterior wall of vagina and opens into it. The cervix communicates above with the body of uterus by an aperture called **internal os**, and with the vagina by an opening, **external os**.
- Walls of the uterus are composed of three layers of tissues,
 - perimetrium**- outer thin covering of peritoneum,
 - myometrium**- middle thick layer of smooth muscle fibres that shows strong contraction during delivery of the baby and
 - endometrium**- inner glandular layer that lines the uterine cavity and undergoes cyclical changes during menstrual cycle.
- After puberty, the uterus goes through the menstrual cycle in absence of fertilization.
- After fertilization, embryo gets attached to the uterine wall, where it is nourished and protected and menstruation is temporarily suspended.

Vagina

- A tube that extends from cervix to the outside of the body.
- A passageway for menstrual flow, receptacle for sperms during intercourse, and part of the birth canal, during labour.
- The opening of vagina, called vaginal orifice is partially covered by a membrane called **hymen**.
- Two Fallopian tubes (oviducts), uterus and vagina constitute the female accessory ducts.

Glands

- **Vestibular glands**: They are of two types-
 - **Lesser vestibular glands/paraurethral glands/ glands of Skene** are numerous minute glands present on either side of urethral orifice; homologous to male prostate and secrete mucus.
 - **Greater vestibular glands/ Bartholin's glands** are paired glands, situated one on each side of vaginal orifice; homologous to bulbo-urethral/ Cowper's glands of male and secrete viscid fluid that supplements lubrication during sexual intercourse.
- **Mammary glands or breasts**: These are modified sweat glands.
 - In females, breasts are undeveloped, until puberty.
 - Externally, each breast has a projection, i.e., **nipple** surrounded by a circular pigmented area of skin called **areola**.
 - Mammary glands consist of glandular, fibroid and adipose tissues.
 - **Glandular tissue** comprises 15-20 lobes in each breast. Each lobe is made up of a number of lobules, which contain grape like clusters of milk secreting glands called **alveoli**.
 - When milk is produced, it passes from alveoli into the **mammary tubules** and then into **mammary ducts**. Near the nipple, mammary ducts expand to form **mammary ampullae**, where some milk may be stored, before going to **lactiferous ducts** from which, it is secreted out.
 - **Fibrous tissue** supports the alveoli and ducts.
 - **Fatty or adipose tissue** is found between the lobes and covers the surface of the gland. The amount of adipose tissue determines the size of the breasts.
 - Main function of mammary glands is secretion and ejection (release) of milk.
 - Milk production is stimulated by hormone prolactin, and ejection of milk by the hormone oxytocin.

Disorders of female reproductive system

- **Breast cancer**
 - It is rarely seen before age of thirty; incidence increases after menopause.
 - Standard treatment is mastectomy.
- **Ectopic pregnancy**
 - It is implantation of embryo at a site other than uterus, generally in the oviduct.
- **Menstrual disorders**
 - Amenorrhea - Absence of menstruation.
 - Menorrhagia - Excessive menstruation.
 - Dysmenorrhea - Painful menstruation.
- **Infertility**
 - In women, infertility is inability to become pregnant.
 - It may be due to failure to ovulate or any anatomical factor which prevents the union of egg and sperm or subsequent implantation.

External genitalia

- Collectively called vulva or pudendum. It is differentiated into the following parts:
 - Mons pubis**: Anterior most portion of the external genitalia, consists of fatty tissue covered by skin and pubic hair.
 - Clitoris**: Posterior to mons pubis; homologous to glans penis of male.
 - Labia majora**: Two large fleshy folds of skin, which form the boundary of vulva; partly covered by pubic hair and contain large number of sebaceous (oil) glands; homologous to scrotum of the male.
 - Labia minora**: Two smaller folds of skin lie under the labia majora; are homologous to penile urethra of male. The area between the labia minora is called **vestibule**. Posteriorly the labia minora are fused to form **fourchette**.
 - Perineum**: The area which extends from the fourchette to anus.